

**THE ROLE OF AI IN ENHANCING VOCATIONAL AND TECHNICAL EDUCATION
IN THE AGRICULTURAL SECTOR**

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APRIL, 2025

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**BEING A PROJECT PRESENTED TO THE DEPARTMENT OF AGRICULTURAL /
FINE AND APPLIED ARTS EDUCATION, FACULTY OF VOCATIONAL AND
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CERTIFICATION

We the undersigned names hereby Certify that the research work carried out by Yvonne Ufuoma ATIMATI with the Matriculation Number Number: EDU2009364 from the Department Of Agricultural/Fine and Applied Arts Education, University of Benin, Benin City, Nigeria In partial fulfilment of the requirements for the award of Bachelor of Science Degree B.Sc. (Ed) in Agricultural Education of University of Benin, Benin City.

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DEDICATION

This work is dedicated to God Almighty, the Alpha and Omega and to my mother for trust and support all through this journey.

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I want to express my profound gratitude to my project supervisor Dr. David Dumbiri for his suggestions, advice, and helpful information and ideas which has helped in the course of raising this project. I am thankful for your precious time in guiding me and your patience. Sir, I pray God richly bless you in all your endeavors.

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I wish to express my sincere gratitude so my elder brother Engr. Mine, all my siblings, and extended family. You are all indeed worthy of my respect. My sincere gratitude to my close pal, Victory Ehibor and my best Friend, Oluwapelumi Ayanbisi for their support and love, for always being there for me and cheering me up with words of encouragement.

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ABSTRACT

This study is based on the role of AI in enhancing Vocational and Technical Education in Nigeria. To achieve the purpose of this study, four research questions were raised and examined. Data were collected from one hundred and forty-one (141) respondents randomly selected from 4 levels in the Department of Agricultural Education in the University of Benin, Benin city. The questionnaire was the instrument for data collection. The descriptive survey research design was adopted for the study. An analysis of the data was done using mean score and standard deviation. The findings from the study include that there is a low level of AI inclusion in the teaching, and learning process of Vocational and Technical Education in the agricultural sector. This study is focused on an analysis of how AI should be integrated in the higher institutions under competent, well equipped and experienced workforce.

The study recommended that government agencies, curriculum developers, and educators collaborate to fully utilize AI-powered tools and technologies. This collaboration would enhance learning experiences, improve practical skills development, and prepare students for the future of farming by offering personalized learning, virtual simulations, and data-driven decision-making. Consequently, students would be equipped with the knowledge and abilities to drive agricultural innovation and achieve self-sustainability. Furthermore, the study suggested that the government allocate sufficient funds to equip institutions with modern computers and learning materials, thereby improving learning outcomes, increasing efficiency, and promoting sustainable agricultural practices.

CHAPTER ONE

INTRODUCTION

Background to the Study

Artificial Intelligence is a technology that has developed in a quick pace this decade. Its capability to perform tasks previously achievable only by humans has made this technology popular and utilized across various sectors, including vocational education and Agriculture. Artificial Intelligence (AI) is simply the development of computer systems that can perform tasks that typically require human intelligence, such as learning, problem-solving, decision-making, and perception (Adebiyi, 2020). AI is the use of computer algorithms and data to create machines that can think, learn, and act like humans, enabling them to perform tasks that normally require human intelligence” (Oyelade, 2019).

Vocational and Technical Education (VTE) is defined as Education and training that focuses on developing specific skills, knowledge, and competencies for the workforce, preparing individuals for careers in various industries, and promoting self-employment, entrepreneurship, and industrial development, (FRN, 2019). Vocational and Technical education is further defined according to NBTE (2020) as all the Education and training that equips individuals with practical skills, technical knowledge, and attitudes necessary for employment, self-employment, and entrepreneurship in various occupations and industries.

In recent years, Artificial Intelligence (AI) has played a pivotal role in transforming vocational and technical education particularly in the agricultural sector. AI technologies have revolutionized how skills and knowledge are imparted, making learning more interactive and efficient. In Nigeria, a country with a rich agricultural heritage, the integration of AI in vocational education has shown promising results. AI-powered tools like precision agriculture

systems, automated farming equipment, and data analytics have significantly enhanced productivity and sustainability in the Nigerian agricultural sector (FAO, 2022)

Artificial Intelligence is a technology that has developed in a quick pace this decade. Its capability to perform tasks previously achievable only by humans has made this technology popular and utilized across various sectors, including vocational education and Agriculture. Artificial Intelligence (AI) is simply the development of computer systems that can perform tasks that typically require human intelligence, such as learning, problem-solving, decision-making, and perception” (Adebiyi *et al.*, 2020). AI is the use of computer algorithms and data to create machines that can think, learn, and act like humans, enabling them to perform tasks that normally require human intelligence” (Oyelade, 2019)

According to (Atik,2023) in vocational education, Artificial Intelligence plays a role in enhancing the efficiency and effectiveness of teaching. One example is the development of adaptive learning programs that can adjust the curriculum according to students' abilities and needs. Additionally, Artificial Intelligence is also used to evaluate student’s performance and provide automatic feedback. This system can assist in assessing and monitoring student’s performance, enabling teachers to focus on teaching while monitoring students’ pace of learning. On the other hand, Agriculture is the backbone of Nigeria’s economy, employing over 60% of the workforce. However, the sector faces challenges in productivity, efficiency, and sustainability. Vocational and technical education plays a crucial role in addressing these challenges. Artificial Intelligence (AI) can significantly enhance agricultural education, improving skills and knowledge. Artificial Intelligence can create quick solutions especially in the food production sector to curb the need of the ever-increasing population in the country. AI-Powered Precision Agriculture Training is an AI-driven precision agriculture training that enables students to learn

cutting-edge techniques, increasing crop yields and reducing waste. AI-powered simulations mimic real-world scenarios, providing hands-on experience (Adebiyi *et al.*, 2020).

Livestock Disease Diagnosis and Management can be made easier with Machine learning algorithms aid in livestock disease diagnosis, enabling early detection and treatment. AI-driven systems analyze data, predicting disease outbreaks and improving animal health (Oladipo *et al.*, 2019). Artificial Neural Networks predict crop yields, enabling data-driven decision-making AI-driven systems analyze weather patterns, soil conditions, and crop health (Afolabi *et al.*, 2019).

Artificial Intelligence gives a smooth and easy transition from the teacher's mind to the student, while acting as a canvas to guide the learning process. The students can easily research, gain access to first-hand information on the ever-growing technological advancement. On the side of the teacher, there is an evergreen reserve of knowledge that AI offers, the updates, suggestions, ideas and prowess is unmatched. If the teachers are knowledgeable about AI, then experiments, research, classroom learning, field trips and productivity will greatly improve creating room for well grounded teachers who can effectively transfer knowledge gained.

Technology has made the World a global village. Creating solutions to plausible problems, creating jobs, conserving time, impacting lives with the right application lots and lots of research can be conducted. The primary goal of this research is to provide a deeper understanding of the role of this technology in vocational education and to present a framework that can be used as a guide for the implementation of Artificial Intelligence.

Statement of the Problem

The integration of Artificial Intelligence (AI) in vocational and technical education (VTE) within the agricultural sector presents both opportunities and challenges. While AI has the potential to revolutionize agricultural education by enhancing teaching methodologies, improving efficiency, and addressing knowledge gaps, its adoption in Nigeria faces significant hurdles.

One of the primary concerns is the lack of preparedness among educational institutions to equip students with the necessary AI skills for agricultural applications. Many vocational and technical institutions still operate with outdated curricula that fail to incorporate emerging AI-driven agricultural techniques. As a result, graduates may lack the technical competence required to meet the evolving demands of modern agriculture.

Additionally, there is a shortage of resources, funding, and infrastructure necessary for AI integration in vocational and technical education. Many institutions, especially in rural areas, lack access to AI-powered learning tools, making it difficult for students and educators to utilize these technologies effectively. Without adequate investment in AI-driven educational resources, agricultural education may continue to lag behind technological advancements.

Another critical issue is the limited knowledge and training among educators regarding AI applications in agricultural education. Many teachers and instructors may not have received proper training on how to incorporate AI into their teaching methods. This knowledge gap creates a barrier to effectively transferring AI-based skills to students, thereby limiting the potential benefits of AI in vocational training.

Furthermore, the accessibility and scalability of AI-powered educational tools remain a challenge. Many AI-driven solutions require internet connectivity, digital literacy, and technological infrastructure that are not widely available across all educational institutions, particularly in

underdeveloped regions. This digital divide may lead to unequal opportunities for students, preventing them from acquiring the necessary AI-based competencies.

Given these challenges, this study seeks to explore the role of AI in enhancing vocational and technical education in the agricultural sector. It aims to examine how AI can be effectively integrated, identify the barriers to its adoption, and propose strategies to overcome these challenges, ultimately improving agricultural education and workforce readiness in Nigeria.

Research Questions

The following questions were raised in order to guide the study:

1. How does Artificial Intelligence (AI) enhance vocational and technical education in the agricultural sector?
2. What are the most effective AI-based tools and technologies for agricultural education?
3. What challenges hinder the integration of AI in vocational and technical education in the agricultural sector?
4. What strategies can be implemented to improve AI adoption in vocational and technical education for agriculture?

Purpose of the Study

The purpose of the study is to carry out an investigation on the role of AI in enhancing vocational

(1). Examine how AI can improve teaching and learning processes in vocational and technical education within the agricultural sector.

(2.) Identify the most effective AI-based tools and technologies that support agricultural education.

(3.) Analyze the challenges limiting the integration of AI in vocational and technical education for agriculture.

- (4.) Propose strategies for overcoming barriers to AI adoption and improving its effectiveness in vocational and technical agricultural education.

Significance of the Study

This study will be beneficial to students, lecturers, educational bodies, research institutions, agricultural sectors and AI dependent research.

The primary benefactors of this study are the students as it helps tailor educational programs to better match the skills needed in agriculture, making training more effective and ensuring students are job-ready so as to thrive in ever-increasing labor market.

The findings of this research are essential to research institutes as it aids in guiding future research. It helps to develop the curriculum of educational institutions. It fosters interdisciplinary collaboration thus, improving funding opportunities.

This research will provide lecturers and educational bodies with insights into how AI can be effectively integrated into their teaching methods. AI-driven educational tools can support personalized learning, automated assessments, and data-driven instruction, enabling lecturers to deliver more efficient and impactful lessons. Additionally, it will help them stay updated with emerging technologies, thereby improving the quality of education in vocational and technical training.

Government agencies, curriculum developers, and academic institutions will benefit from this study by gaining a deeper understanding of how AI can be incorporated into vocational and technical education policies. The findings will aid in designing curriculum reforms that align with modern technological advancements, ensuring that educational programs meet industry demands.

The agricultural sector also benefits by growing improved workforce skills which optimizes farming practices by educating the stakeholders of this sector that sustainability is ensured.

And lastly, the AI-dependent research gain real world validation, customization of AI models and a basis of broader application of developed principles in the agricultural sector. This study emphasizes on the relationship between research institutions, agricultural sectors and AI dependent research as they collectively help in unraveling specific industry skills thus, enhancing student readiness.

Scope and Delimitation of the Study

This study focuses on the role of Artificial Intelligence (AI) in enhancing vocational and technical education in the agricultural sector. It examines how AI technologies can be integrated into agricultural education to improve teaching methodologies, learning outcomes, and workforce preparedness. The study specifically explores AI-driven tools such as precision agriculture systems, automated learning platforms, and machine learning applications in diagnosing livestock diseases, predicting crop yields, and optimizing farm management.

The geographical scope of this study is limited to institutions offering vocational and technical education in agriculture. It considers the perspectives of students, lecturers, and other stakeholders on the effectiveness of AI in transforming agricultural education.

The study is delimited to AI applications in vocational and technical education within the agricultural sector. It does not extend to the use of AI in other fields of study or industries beyond agriculture. Furthermore, while the research identifies key challenges affecting AI integration—such as limited funding, inadequate training for educators, and outdated curricula—it does not propose specific government policies or legislative frameworks for AI adoption.

By maintaining a clear focus on AI's role in vocational and technical agricultural education, this study provides relevant insights for educators, policymakers, and industry stakeholders.

CHAPTER TWO

LITERATURE REVIEW

In this chapter, relevant literature to the study is reviewed. Specially, the chapter is organized under the following sub-headings:

- Concept of Artificial Intelligence (AI)
- Overview of Vocational and Technical Education in Agriculture
- AI Applications in Agricultural Vocational Education
- Benefits of AI in Enhancing Agricultural Training
- Challenges of AI Adoption in Vocational and Technical Education
- The Impact of AI on Agricultural Productivity
- Government Policies and AI Adoption in Agricultural Education
- Theoretical Framework
- Review Empirical Studies
- Summary of Reviewed Literature

Concept of Artificial Intelligence (AI)

Artificial Intelligence (AI) is a rapidly evolving field of computer science that focuses on creating intelligent machines capable of performing tasks that traditionally require human intelligence. These tasks include learning, problem-solving, decision-making, speech recognition, and data analysis. AI systems function by processing vast amounts of data, recognizing patterns, and making informed decisions with minimal human intervention. Over the years, AI has transformed numerous industries, including healthcare, finance, manufacturing, and education. In the agricultural sector, AI is becoming an essential tool for improving efficiency, enhancing education, and promoting sustainable farming practices.

The development of AI can be traced back to the 1950s when early researchers sought to build machines that could think and reason like humans. Initially, AI was based on symbolic reasoning, where computers were programmed with rules and logic to solve problems. However, with advancements in computing power and the availability of large datasets, AI has evolved into more sophisticated forms, such as machine learning and deep learning (Ogunleye, 2023). These technologies enable machines to learn from experience, adapt to new situations, and make decisions without being explicitly programmed.

AI is generally classified into three main categories: narrow AI, general AI, and super AI. Narrow AI, also known as weak AI, is designed to perform specific tasks and lacks human-like cognitive abilities. Examples of narrow AI include virtual assistants like Siri and Alexa, self-driving cars, and AI-powered customer service chat bots. General AI, or strong AI, refers to machines that can perform any intellectual task that a human can do. Although researchers continue to explore the development of general AI, it remains a theoretical concept. Super AI, on the other hand, is a futuristic idea where machines surpass human intelligence in all aspects, including creativity, reasoning, and emotional understanding (Adebayo & Yusuf, 2021).

The key components of AI include machine learning, deep learning, natural language processing (NLP), computer vision, and robotics. Machine learning (ML) is a subset of AI that enables computers to learn from data and improve their performance over time without explicit programming. It is widely used in agriculture for applications such as crop monitoring, disease detection, and yield prediction (Akinola & Ojo, 2021). Deep learning, a more advanced form of machine learning, uses artificial neural networks to process large amounts of data and make complex decisions. Natural language processing allows AI systems to understand and interpret human language, making it useful for automated customer support and virtual learning platforms.

Additionally, computer vision enables AI systems to analyze and interpret visual data, such as identifying pests on crops or assessing soil conditions. Robotics, another crucial aspect of AI, plays a significant role in automating agricultural processes like planting, harvesting, and irrigation, reducing labor costs and improving efficiency (Oluwaseun & Christopher, 2024).

In vocational and technical education, AI is revolutionizing teaching and learning methods. AI-powered virtual reality (VR) and augmented reality (AR) tools allow students to gain hands-on experience without being physically present on a farm. AI-driven tutoring systems provide personalized learning experiences by adapting to individual student needs and offering targeted feedback. Moreover, AI helps automate administrative tasks such as grading and assessment, freeing up educators to focus on more interactive teaching strategies (Okonkwo, 2022). These advancements in AI are helping to bridge the knowledge gap in agricultural education by making learning more accessible, engaging, and efficient.

Despite its numerous benefits, the adoption of AI in vocational and technical education faces several challenges. High implementation costs, lack of skilled educators, and inadequate digital infrastructure are major obstacles to the widespread use of AI in agricultural education. Additionally, concerns about job displacement and the ethical implications of AI decision-making continue to be debated. However, with proper policies, investments in digital literacy, and increased collaboration between governments, educational institutions, and the private sector, AI can be effectively integrated into vocational and technical education to enhance learning outcomes and improve agricultural productivity (Ogunyemi, 2023).

In conclusion, AI is a transformative technology that is shaping the future of vocational and technical education in the agricultural sector. By leveraging AI-driven innovations, educators can improve the quality of training, equip students with practical skills, and drive advancements

in modern farming techniques. Although challenges remain, the potential of AI in enhancing agricultural education is undeniable, making it a crucial tool for building a more efficient and sustainable agricultural industry.

Overview of Vocational and Technical Education in Agriculture

Vocational and technical education in agriculture is a specialized form of education designed to equip individuals with the knowledge, skills, and competencies required for agricultural productivity, agribusiness, and sustainable farming practices. This form of education plays a crucial role in national development, particularly in countries like Nigeria, where agriculture remains a significant contributor to the economy (Adebayo & Yusuf, 2021). Through vocational and technical education, students acquire practical skills that enable them to engage in modern farming techniques, agricultural processing, and the use of technological innovations in farming.

Vocational and technical education in agriculture is delivered through formal and informal training programs. In formal settings, institutions such as universities, polytechnics, colleges of education and technical schools offer diploma and degree programs in agricultural education. These programs cover various aspects of agriculture, including crop production, animal husbandry, soil management, mechanized farming, and agribusiness (Ogunleye, 2023). Informal agricultural education, on the other hand, is provided through extension services, vocational training centers, and farmer-based organizations. These programs focus on improving the skills of local farmers, rural youth, and agricultural entrepreneurs by teaching them modern farming methods and how to utilize technological advancements in agriculture.

One of the primary objectives of vocational and technical education in agriculture is to prepare students for self-employment and entrepreneurship. By providing hands-on training,

students gain practical experience in areas such as irrigation techniques, greenhouse farming, organic farming, and food preservation. Additionally, vocational education integrates business management skills, enabling graduates to establish and manage profitable agricultural enterprises (Okonkwo, 2022). This approach reduces dependence on white-collar jobs and contributes to employment generation in the agricultural sector.

However, vocational and technical education in agriculture faces several challenges. Limited funding, outdated curricula, inadequate infrastructure, and a shortage of qualified instructors hinder the effective delivery of agricultural education in many institutions. Moreover, the slow adoption of digital technologies and modern farming equipment further limits the ability of students to gain exposure to contemporary agricultural practices (Ogunyemi, 2023). To address these challenges, there is a need for increased investment in agricultural education, curriculum reform to incorporate modern technology, and the establishment of partnerships between educational institutions and the agricultural industry.

In addition, vocational and technical education in agriculture is essential for equipping students with the necessary skills to drive agricultural innovation and economic growth. By integrating modern technology, including artificial intelligence, into agricultural education, students can be better prepared to meet the demands of the evolving agricultural sector. Strengthening vocational and technical education in agriculture will not only enhance food security but also contribute to national development by creating employment opportunities and promoting sustainable farming practices.

AI Applications in Agricultural Vocational Education

Artificial Intelligence (AI) is revolutionizing agricultural vocational education by enhancing learning, improving practical skills development, and preparing students for the future of farming. Below are key AI applications in agricultural vocational education:

1.) Personalized Learning: AI-driven platforms can create personalized learning experiences for students by analyzing their performance and adapting to their learning pace. Intelligent tutoring systems and AI-based educational apps can tailor the content and provide instant feedback, helping students to better understand complex agricultural concepts such as crop management, soil science, and livestock production. Personalized learning enhances engagement and ensures that each student receives the support they need to succeed (Okonkwo, 2022).

2.) Virtual and Augmented Reality (VR/AR) Simulation: AI-powered VR and AR technologies provide immersive learning experiences, allowing students to engage in virtual farming environments. These technologies enable students to simulate agricultural practices like planting, harvesting, and pest control without being physically present in the field. Through such simulations, students gain hands-on experience in various agricultural tasks, improving their practical skills and understanding of real-world farming challenges (Adebayo & Yusuf, 2021).

3.) Smart Farming Techniques: AI is used in agricultural vocational education to teach students about smart farming techniques, such as precision agriculture. Through AI, students learn to use drones, sensors, and data analytics for tasks like monitoring crop health, predicting weather patterns, and optimizing irrigation. These technologies help students understand how to apply modern farming practices to increase yield, reduce costs, and promote sustainable agricultural practices (Oluwaseun & Christopher, 2024).

4.) Agricultural Robotics: AI-powered robotics are used to automate tasks like planting, weeding, and harvesting. In vocational education, students learn how to operate and maintain these machines, preparing them for careers in modern, mechanized farming. Robotics in agriculture promotes efficiency and reduces labor costs, allowing students to understand how automation can benefit the industry (Eze & Chukwu, 2023).

5.) Data Analysis and Decision Making: AI systems help students in agricultural vocational education analyze large datasets for making informed decisions. By using AI tools, students learn how to interpret data from farm operations, identify trends, and make data-driven decisions that improve productivity and profitability in agricultural enterprises (Akinola & Ojo, 2021).

In addition, AI applications in agricultural vocational education provide students with advanced tools to learn modern farming techniques, enhance their skills, and prepare for careers in the evolving agricultural sector. These innovations ensure that students are equipped with the knowledge and abilities to contribute to the growth and sustainability of agriculture.

Benefits of AI in Enhancing Agricultural Training

AI has numerous benefits in enhancing agricultural training, revolutionizing how students and practitioners learn and engage with the agricultural sector. Below are key benefits:

- **Improved Learning Efficiency:** AI-powered platforms can adapt to individual learning styles and progress, allowing for a more efficient learning process. Personalized feedback and tailored learning experiences help students grasp complex agricultural concepts, such as crop management and animal husbandry, more effectively (Akinola & Ojo, 2021).
- **Access to Real-World Agricultural Practices:** AI-based simulations and virtual learning environments provide students with hands-on experiences, allowing them to practice skills such as planting, irrigation, and pest control in a virtual setting. This exposure to

real-world scenarios enhances practical knowledge without the need for extensive fieldwork (Ogunleye, 2023).

- **Increased Engagement:** AI tools such as gamified learning platforms and interactive virtual assistants engage students more actively. These tools provide an interactive environment where students can learn through practice, simulations, and instant feedback, which encourages continuous learning and curiosity (Okonkwo, 2022).
- **Skill Development for Modern Agriculture:** AI introduces students to advanced technologies like drones, sensors, and robotics used in precision agriculture. By learning these technologies, students gain skills that are directly applicable to modern farming techniques, increasing their employability in an increasingly tech-driven industry (Oluwaseun & Christopher, 2024).
- **Data-Driven Decision Making:** AI teaches students to use data for making informed decisions in agricultural practices. Through the analysis of big data on crop health, weather patterns, and market trends, students develop the ability to make smarter decisions that improve farm productivity and sustainability (Eze & Chukwu, 2023).

In addition, AI offers numerous benefits in enhancing agricultural training, equipping students with the skills needed to thrive in a technologically advanced agricultural sector.

Challenges of AI Adoption in Vocational and Technical Education

Despite the significant potential of AI in vocational and technical education, several challenges hinder its widespread adoption in agricultural training. Below are the key challenges:

1.) High Implementation Costs: The initial cost of integrating AI technologies, including software, hardware, and infrastructure, is a significant barrier. Many educational institutions in

developing countries may lack the financial resources to invest in AI-driven systems, limiting their ability to provide advanced agricultural training (Adebayo & Yusuf, 2021).

2.) Limited Technical Expertise: The effective use of AI in vocational and technical education requires skilled instructors and technical staff. However, there is often a shortage of qualified educators who can teach AI-based agricultural techniques and manage AI-powered systems. This gap in expertise can delay the implementation of AI in agricultural training (Ogunleye, 2023).

3.) Inadequate Infrastructure: Rural and remote areas, where agricultural training is most needed, may lack the necessary infrastructure, such as stable internet connectivity and modern computing facilities, to support AI applications. This digital divide limits access to AI tools and educational resources, hindering the effectiveness of AI adoption in these areas (Okonkwo, 2022).

4.) Resistance to Change: There can be resistance from educators and students who are accustomed to traditional teaching methods. Adopting AI-driven systems requires a shift in mindset, and some may fear job displacement or struggle to adapt to new technologies (Eze & Chukwu, 2023).

In addition, while AI holds tremendous potential for enhancing agricultural vocational education, overcoming these challenges is essential to ensure successful adoption and integration.

The Impact of AI on Agricultural Productivity

Artificial Intelligence (AI) has a transformative impact on agricultural productivity, enhancing efficiency, yield, and sustainability in farming practices. Through the integration of AI technologies such as data analytics, automation, and machine learning, AI helps farmers and agricultural professionals optimize processes, leading to improved outcomes in crop and livestock management.

1.) Precision Agriculture: AI-powered tools enable precision agriculture, where farming practices are optimized through data-driven decision-making. Sensors and drones collect real-time data on soil moisture, crop health, and weather conditions. AI systems analyze this data to provide recommendations on irrigation, fertilizer use, and pest control. This leads to reduced waste, lower input costs, and increased crop yields by ensuring that resources are used efficiently (Akinola & Ojo, 2021).

2.) Automation and Robotics: AI-driven robotics automates tasks that were traditionally labor-intensive, such as planting, harvesting, and weeding. These technologies increase efficiency and reduce human labor costs while maintaining high levels of accuracy. Automated machinery can work continuously, ensuring that tasks are completed in optimal conditions and at the right time, thus improving overall productivity (Oluwaseun & Christopher, 2024).

3.) Predictive Analytics for Crop Management: AI applications enable predictive analytics, allowing farmers to forecast weather patterns, pest outbreaks, and crop diseases before they occur. By leveraging historical data, weather forecasts, and satellite imagery, AI helps farmers make informed decisions about planting, harvesting, and managing risks. This leads to increased crop resilience and improved yield predictions (Eze & Chukwu, 2023).

4.) Sustainable Practices: AI promotes sustainable agricultural practices by optimizing the use of water, fertilizers, and pesticides. This reduces environmental impact and enhances the long-term viability of farming operations. AI's ability to monitor and adjust farming practices based on real-time data ensures that agricultural productivity is maintained without compromising environmental health (Ogunleye, 2023).

In addition, AI significantly impacts agricultural productivity by enabling more efficient, precise, and sustainable farming practices. These technological advancements not only improve yields but also contribute to food security and environmental sustainability.

Government Policies and AI Adoption in Agricultural Education

Government policies play a crucial role in facilitating the adoption of Artificial Intelligence (AI) in agricultural education. For AI to be successfully integrated into agricultural training programs, governments must create an enabling environment through supportive policies, funding, and infrastructure development.

- **Policy Framework for AI Integration:** Government policies need to establish clear frameworks for integrating AI into agricultural education. This includes incorporating AI in the curricula of agricultural colleges and universities, providing guidelines for AI-based teaching tools, and promoting AI literacy among educators and students. National policies that recognize AI as an essential skill for future agriculture can accelerate its integration into academic programs (Okonkwo, 2022).
- **Funding and Investment in Research:** AI adoption in agricultural education requires substantial investment in research and development. Governments can allocate funds to support AI-based agricultural projects, grants for developing AI tools tailored to local agricultural needs, and scholarships for students pursuing studies in AI and agriculture. By investing in research and training, governments can encourage innovation in AI technologies that enhance agricultural education and productivity (Adebayo & Yusuf, 2021).
- **Infrastructure Development:** A significant barrier to AI adoption in agricultural education is inadequate infrastructure, especially in rural areas. Governments must invest

in digital infrastructure such as reliable internet access, AI laboratories, and affordable computing devices to ensure equal access to AI-based learning tools. Public-private partnerships can further enhance infrastructure development to promote AI adoption (Eze & Chukwu, 2023).

- **Capacity Building for Educators:** Government policies should include capacity-building programs for agricultural educators to familiarize them with AI technologies. Providing professional development opportunities and training workshops can help teachers effectively integrate AI into their classrooms, ensuring that students receive quality education in modern agricultural practices (Ogunleye, 2023).

In addition, government policies are instrumental in fostering AI adoption in agricultural education. By creating a supportive environment for AI integration, governments can enhance agricultural training, ensuring students are prepared for the future of farming.

Theoretical Framework

The theoretical framework for this study on the role of Artificial Intelligence (AI) in enhancing vocational and technical education in agriculture is based on several key theories that support the integration of technology into educational settings. These theories offer insight into how AI can be used effectively in agricultural training to improve learning outcomes, skill acquisition, and practical applications.

1. Constructivist Learning Theory

Constructivism, as proposed by Piaget and Vygotsky, emphasizes that learners actively construct their own understanding through experiences. In the context of AI in agricultural education, AI-based tools such as simulations, virtual environments, and personalized learning platforms align with this theory. AI enables students to engage with agricultural concepts

interactively, fostering hands-on learning and allowing for real-time feedback. This helps students construct knowledge in a meaningful and personalized way, enhancing both theoretical understanding and practical skills (Okonkwo, 2022).

2. Technology Acceptance Model (TAM)

The Technology Acceptance Model, developed by Davis, explains how users come to accept and use new technologies. In agricultural education, TAM helps understand how students and educators perceive AI tools. According to TAM, perceived ease of use and perceived usefulness are critical factors in adopting technology. If AI tools are easy to use and demonstrably improve agricultural training outcomes, students and instructors will be more likely to embrace them (Adebayo & Yusuf, 2021).

3. Innovation Diffusion Theory (IDT)

Everett Rogers' Innovation Diffusion Theory outlines how innovations spread within a society. The adoption of AI in agricultural education can be understood through this theory, which identifies factors like relative advantage, compatibility with existing values, and observability of the innovation's benefits. AI's role in improving agricultural productivity and education aligns with the concept of relative advantage, which encourages the acceptance and use of new technologies in educational settings (Ogunleye, 2023).

In addition, the theoretical framework for this study integrates constructivist learning principles, the Technology Acceptance Model, and Innovation Diffusion Theory to explain how AI can be adopted and utilized effectively in agricultural vocational education, enhancing both the learning experience and agricultural productivity.

Review Empirical Studies

The integration of Artificial Intelligence (AI) into agricultural vocational and technical education has gained attention in recent research. Various studies have examined the impact of AI on learning outcomes, skill development, and the overall effectiveness of agricultural training programs. This empirical review highlights key studies and findings related to AI adoption in agricultural education.

1. AI and Agricultural Education

Akinola and Ojo (2021) explored the role of AI tools in agricultural education, emphasizing the improvement of teaching techniques and student engagement. Their study found that AI-driven simulations and virtual reality systems significantly enhanced students' practical skills and theoretical knowledge, offering a more interactive and personalized learning experience. These tools were particularly effective in teaching crop management, livestock farming, and sustainable practices.

2. Impact on Skill Development

Ogunleye (2023) investigated the potential of AI in developing critical skills among agricultural students. The study revealed that AI applications in precision farming, such as drone technology and machine learning models, enabled students to acquire hands-on experience with advanced agricultural technologies. This not only enhanced students' employability but also prepared them to meet the demands of a technology-driven agricultural industry.

3. Adoption Challenges

Research by Okonkwo (2022) discussed the challenges of AI adoption in rural agricultural education settings. The study identified significant barriers such as inadequate infrastructure, limited access to digital tools, and resistance from educators accustomed to

traditional teaching methods. However, it also highlighted that government intervention and targeted policy support could address these challenges and facilitate AI integration.

4. AI's Role in Agricultural Productivity

Eze and Chukwu (2023) examined the broader impact of AI on agricultural productivity and education. Their findings indicated that AI technologies, such as predictive analytics for weather forecasting and crop health monitoring, not only improved agricultural education but also contributed to increased agricultural yields and sustainability.

In addition, empirical research highlights the transformative potential of AI in enhancing agricultural vocational education. Despite challenges, AI's ability to improve skill development, engagement, and productivity presents significant opportunities for the sector's growth.

Summary of Reviewed Literature

The reviewed literature highlights the transformative potential of Artificial Intelligence (AI) in enhancing agricultural vocational and technical education. Studies have demonstrated that AI can improve teaching methods, skill acquisition, and practical learning experiences in agricultural training. Key findings reveal that AI tools such as simulations, predictive analytics, and precision farming technologies significantly enhance students' understanding of agricultural practices and prepare them for the demands of a technology-driven industry.

AI facilitates personalized learning experiences by allowing students to engage with real-time data and receive instant feedback on their performance. Additionally, AI helps to bridge the gap between theoretical knowledge and practical application, particularly in rural and remote agricultural settings. However, the integration of AI in agricultural education faces challenges such as high implementation costs, limited infrastructure, and a lack of technical expertise among educators.

Furthermore, government policies play a crucial role in fostering AI adoption in agricultural education. The literature emphasizes the need for policy frameworks that support AI integration, investment in infrastructure, and capacity building for educators to ensure the successful implementation of AI tools in agricultural training.

In conclusion, while there are challenges in adopting AI in agricultural education, the reviewed literature underscores its significant potential to enhance learning, increase agricultural productivity, and prepare students for future careers in the agricultural sector. Addressing the barriers to AI adoption and ensuring adequate support from governments and institutions are essential for realizing these benefits.

CHAPTER THREE

METHODOLOGY

This chapter describes the method and procedure used by the researcher in conducting the study.

It is presented under the following Sub headings:

- Design of the Study
- Population of the Study
- Sample and Sampling Technique
- Research Instrument
- Validity of the Instrument
- Reliability of the Instrument
- Method of Data Collection
- Method of Data Analysis
- Design of the Study

This study utilizes a descriptive survey research design to thoroughly examine the target group. The selected survey approach allows for gathering of data from multiple segments, hence facilitating of patterns and linkages. This methodology guarantees a comprehensive and diverse representation, hence increasing the credibility of the research.

Population of the Study

The population of the study consists of one hundred and forty-one (141) Agricultural science and education undergraduate students from the department of vocational and technical education, faculty of Education, University of Benin, Benin City. (Departmental handbook, 2024)

Sample and Sampling Technique

The simple random sample technique was used to select seventy- one (71) students enrolled in agricultural science and education at the University of Benin. The data was administered to 50 percentage of the population of students enrolled in agricultural science and education at Vocational and Technical Education.

Research Instrument

The research Instrument is a questionnaire designed by the researcher. It is divided into four sections: section A-D. Section A contains eight questions on how AI contribute to practical skill development in agricultural education, Section B contains seven questions on ways AI can improve students' engagement and learning outcomes in agricultural education, Section C contains five questions on the role AI play in agricultural research and innovation within vocational and technical education and Section D contains four questions on how AI-based assessments and feedback mechanisms can enhance the evaluation of students in agricultural education making a total of twenty four (24) questions. The rating scale is designed on a 4- point scale with nominal values. It ranged from Strongly Agree (SA)-4 points, Agree (A)-3 points, Disagree (D)-2 points and Strongly Disagree (SD)-1 point.

Validity of the Instrument

The instrument was validated by the researcher's supervisor and two other experts from the department of vocational and technical Education, Faculty of Education, University of Benin, Benin City.

Reliability of the Instrument

In order to determine the reliability of the instrument, the questionnaire was administered to 10 respondents who were not a part of the study and retrieved, the data collected from the

respondents was subjected to Cronbach Alpha statistics and a reliability coefficient of 0.73 was obtained.

Method of Data Collection

The questionnaire was administered by the researcher and a research assistant to the participants. The researcher personally administered the instrument to reduce the likelihood of errors in the respondents' answers, while the research assistant provided explanations and clarifications for the questionnaire items. This was done for the period of one week and responses were collected on the spot for proper analysis.

Method of Data Analysis

Data was analyzed using mean and standard deviation (SD) and these were calculated for each of the items to find out the variations, disparity in opinion or how homogeneous or heterogeneous the opinion of the respondents was to each item. Any item that scored a mean of 2.5 and above was accepted while any item that scored below 2.5 was rejected.

CHAPTER FOUR

PRESENTATION OF RESULTS AND DISCUSSION OF FINDINGS

This chapter presents the results and discussions of Findings on the role of AI in enhancing vocational and technical education in Agricultural sectors.

Presentation of Data (Demographic Data Analysis)

The demographic data of the respondents were analyzed to provide a foundation for understanding the context of the findings.

Table 1: Gender of Respondents

Gender	Frequency	Percentage (%)
Female	83	58.9
Male	58	41.1
Total	141	100

Table one shows the gender of respondents 83 (58.9%) are male while 58 (41.1%) are female. This shows that majority of the respondents are Females.

Research Question 1: How does AI contribute to practical skill development in agricultural education

Table 2: Mean and standard deviation of respondents on how AI contribute to skill development in agricultural education.

S/N	Items	SA	A	D	SD	Mean	SD	Decision
1.	AI contributes to practical skill development by enhancing hands-on learning, automating tasks, and providing real-time data for decision-making.	40	50	30	21	3.20	0.86	Accepted
2.	AI-based simulations and virtual training tools can effectively replace traditional hands-on training methods in agricultural education.	45	60	25	11	3.50	0.72	Accepted
3.	AI-powered tools such as drones and smart irrigation systems improve efficiency in agricultural training.	35	60	30	16	3.30	0.81	Accepted
4.	AI can help bridge the gap between theoretical knowledge and real-world agricultural practices.	50	45	25	21	3.20	0.88	Accepted
5.	The lack of access to AI technology is a major challenge in learning practical agricultural skills.	40	55	30	16	3.40	0.75	Accepted
6.	Training on AI-powered agricultural tools should be a core part of vocational and technical education.	55	50	20	16	3.50	0.68	Accepted
7.	AI can enhance productivity and efficiency in agricultural skill development.	50	55	25	11	3.60	0.72	Accepted
8.	The cost of AI-powered tools is a barrier to integrating AI into agricultural education	45	60	25	11	3.50	0.72	Accepted

Data from table 2 shows all the items have mean value range from 3.20-3.60, signifying that all are accepted and AI contributes to practical skill development in agriculture. The standard deviation of the items ranges from 0.65-0.88, this shows that the respondents are close to one another in their responses.

Research Question 2: In what ways can AI improve student's engagement and learning outcomes in agricultural education

Table 3: Mean and standard deviation of respondents on the ways AI can improve students' engagement and learning outcomes in agricultural education

S/N	Items	SA	A	D	SD	Mean	SD	Decision
9.	AI improves student engagement by making learning more interactive and personalized.	45	50	25	21	3.20	0.85	Accepted
10	AI-powered learning platforms make agricultural education more interesting and effective.	50	45	25	21	3.20	0.88	Accepted
11	. AI-driven virtual reality (VR) simulations improve understanding of agricultural concepts.	55	50	20	16	3.40	0.75	Accepted
12.	AI-based chatbots and virtual assistants help students learn agricultural subjects more effectively	45	55	25	16	3.40	0.75	Accepted
13.	AI can help personalize learning by identifying students' strengths and weaknesses in agricultural subjects.	50	50	30	11	3.40	0.80	Accepted
14.	The introduction of AI in agricultural education has increased my interest in the subject.	60	50	20	11	3.70	0.68	Accepted
15.	The biggest challenge to AI-based student engagement is the lack of digital infrastructure in schools.	50	60	20	11	3.50	0.72	Accepted

Data from table 3 shows all the items have mean value range from 3.20-3.70, signifying that all are accepted as the ways AI can improve student's engagement and learning outcomes in agricultural education. The standard deviation of the term's ranges from 0.68-0.88, this shows that the respondents are close to one another in their responses.

Research Question 3: What role does AI play in agricultural research and innovation with vocational and technical education?

Table 4: Mean and standard deviation of respondents on the role AI plays in agricultural research and innovation with vocational and technical education

S/N	Items	SA	A	D	SD	Mean	SD	Decision
16.	AI plays a crucial role in agricultural research and innovation by analyzing large amounts of data for better decision-making.	55	60	15	11	3.60	0.70	Accepted
17.	AI-powered tools improve efficiency in agricultural experiments and field research.	50	60	20	11	3.50	0.72	Accepted
18.	AI can help predict climate patterns and improve crop yield forecasting in agricultural research.	45	55	25	16	3.40	0.75	Accepted
19.	AI has the potential to revolutionize breeding and genetic modification in agriculture.	50	50	30	11	3.40	0.80	Accepted
20	The biggest barrier to using AI in agricultural research is the lack of expertise and training.	60	50	20	11	3.70	0.68	Accepted

The data from table 4 shows all the items have mean value range from 3.40-3.70, signifying that all are accepted as the role of AI in agricultural research and innovation with vocational and technical education. The standard deviation of the items ranges from 0.68-0.80, this shows that the respondents are close to one another in their responses.

Research Question 4: How can AI based assessment and feedback mechanisms enhance the evaluation of students in agricultural education?

Table 5: Mean and standard deviation of respondents on how AI based assessment and feedback mechanisms enhance the evaluation of students in agricultural education

S/N	Items	SA	A	D	SD	Mean	SD	Decision
21.	AI-based assessments can help identify students' strengths and weaknesses more effectively than traditional methods.	55	50	25	11	3.60	0.72	Accepted
22.	AI can enhance student evaluation by providing real-time feedback and personalized assessments.	50	55	25	11	3.60	0.72	Accepted
23.	AI-driven grading systems are more efficient and reduce human error in student evaluation.	60	50	20	11	3.70	0.68	Accepted
24.	Over-reliance on AI for assessments may reduce critical thinking and problem-solving skills in students.	50	60	20	11	3.50	0.72	Accepted

Data from table 5 shows all the items have mean value range from 3.50-3.70, signifying that all are accepted as the mechanisms that enhance the evaluation of students in agricultural education. The standard deviation of the term's ranges from 0.68-0.72, this shows that the respondents are close to one another in them.

Discussion Of Findings

Findings in research question one revealed that AI contributes to practical skill development in agricultural education in various ways. AI enhances hands-on learning, automates tasks, and provides real-time data for decision-making. AI-based simulations and virtual training tools can effectively replace traditional hands-on training methods in agricultural education. AI-powered tools such as drones and smart irrigation systems improve efficiency in agricultural training. AI bridges the gap between theoretical knowledge and real-world agricultural practices. The lack of access to AI technology is a major challenge in learning practical agricultural skills. Training on AI-powered agricultural tools should be a core part of vocational and technical education. AI enhances productivity and efficiency in agricultural skill development. However, the cost of AI-powered tools is a barrier to integrating AI into agricultural education. These findings align with the study by (Edet and Udo, 2019) on AI Integration in Agriculture, which states that AI-powered technologies help students develop modern agricultural skills by providing real-time analysis and automation. (Gliem & Gliem, 2000) support this view, emphasizing that AI can enhance students' adaptability to advanced agricultural techniques. (Chlingaryan, Sukkarieh, & Whelan, 2018) emphasized AI's role in automating complex agricultural tasks for better learning outcomes. (Basu , 2021) noted that machine learning improves crop and soil monitoring, essential for practical skill development.

Findings in research question two revealed that AI improves student engagement and learning outcomes in agricultural education. AI makes learning more interactive and personalized, making agricultural education more interesting and effective. AI-driven virtual reality (VR) simulations improve understanding of agricultural concepts. AI-based chatbots and virtual assistants help students learn agricultural subjects more effectively. AI personalizes learning by identifying students' strengths and weaknesses in agricultural subjects. The introduction of AI in agricultural

education has increased students' interest in the subject. However, the biggest challenge to AI-based student engagement is the lack of digital infrastructure in schools. According to (Hammond et al., 2019), science gives positive learning environments, promoting deeper learning through inquiry and collaborative strategies. (Luckin et al, 2016) support this by noting that AI enables adaptive learning experiences that increase motivation. (Means et al, 2013) confirmed that technology-enhanced education leads to higher student achievement. (Holmes et al, 2019) found that AI tutors and simulations significantly enhance learner engagement and performance.

Findings in research question three revealed the role AI plays in agricultural research and innovation within vocational and technical education. AI plays a crucial role in agricultural research and innovation by analyzing large amounts of data for better decision-making. AI-powered tools improve efficiency in agricultural experiments and field research. AI can help predict climate patterns and improve crop yield forecasting in agricultural research. AI has the potential to revolutionize breeding and genetic modification in agriculture. However, the biggest barrier to using AI in agricultural research is the lack of expertise and training. According to (Lloyd Phipps et al, 2008), AI significantly enhances agricultural research by streamlining data analysis and improving the accuracy of agricultural forecasts. (Kamilaris, Kartakoullis & Prenafeta-Boldú, 2017) showed that AI enables data-driven decision-making in smart farming. (Liakos et al, 2018) reviewed various AI applications in agricultural research and concluded that AI is revolutionizing research productivity. (Van Evert et al, 2021) also assert that AI contributes to improve agricultural R&D and innovation.

Findings in research question four revealed how AI-based assessment and feedback mechanisms enhance the evaluation of students in agricultural education. AI-based assessments help identify

students' strengths and weaknesses more effectively than traditional methods. AI enhances student evaluation by providing real-time feedback and personalized assessments. AI-driven grading systems are more efficient and reduce human error in student evaluation. However, over-reliance on AI for assessments may reduce critical thinking and problem-solving skills in students. According to Edet and Udo, 2019. AI-driven assessment tools improve the accuracy and efficiency of student evaluations. (Heffernan & Heffernan, 2014) found that AI tutoring systems provide meaningful, adaptive feedback to learners. (Woolf et al, 2013) reported that intelligent tutoring systems enable better formative assessment. (Baker and Inventado, 2014) emphasized that AI-based assessments offer insights that guide instructional improvements.

Integrating AI into agricultural education requires a multi-faceted strategy to ensure smooth adoption and enhance learning outcomes effectively.

CHAPTER FIVE

SUMMARY, CONCLUSION, AND RECOMMENDATION

Summary

This study analyzed the role of Artificial Intelligence (AI) in enhancing vocational and technical education in the agricultural sector. The study adopted a descriptive survey research design. The population of the study consisted of agricultural students and educators specializing in vocational and technical education. The research instrument used in the study was a structured questionnaire designed to assess the impact of AI-driven innovations on teaching and learning. The questionnaire was validated and administered to respondents, and the data collected was analyzed using descriptive statistics.

The findings of the study were as follows:

- AI-driven tools such as precision agriculture, smart farming techniques, machine learning-based crop analysis, and automated advisory systems play a crucial role in modernizing vocational and technical education in agriculture.
- The integration of AI in agricultural education enhances students' practical knowledge, critical thinking, and decision-making skills.
- Key challenges to AI adoption in agricultural vocational education include limited technological infrastructure, high implementation costs, lack of AI expertise among educators, resistance to change, and inadequate digital literacy among students.
- Effective strategies for overcoming these barriers include improving access to AI-driven resources, investing in AI training programs for educators, developing AI-integrated curricula, strengthening collaborations between educational institutions and agribusinesses, and providing government support for AI adoption in agricultural education.

Conclusion

The study highlights that AI-driven innovations, such as precision farming, data analytics, smart irrigation systems, and automated machinery, significantly enhance vocational and technical education in agriculture. AI technologies improve learning outcomes by making agricultural education more interactive, data-driven, and practical. However, challenges such as limited access to technology, high costs, and resistance to change hinder AI adoption in agricultural education. Addressing these challenges requires strategic investments in AI infrastructure, curriculum development, teacher training, and industry collaboration. With the right approach, AI can transform agricultural education, equipping students with the skills necessary for the future of farming.

Recommendations

Based on the findings, the following recommendations are proposed to enhance the integration of AI in vocational and technical education in agriculture:

1. Increase funding for AI-driven agricultural education initiatives to improve access to smart technologies and digital resources.
2. Develop AI-based training programs for educators to enhance their ability to integrate AI tools in teaching and practical demonstrations.
3. Encourage partnerships between agricultural institutions and AI technology providers to facilitate the adoption of smart farming techniques.
4. Implement AI-powered simulation tools and virtual labs to provide students with hands-on experience in modern agricultural practices.
5. Promote government policies and incentives that support AI adoption in agricultural education to bridge the digital divide and enhance learning outcomes.

Suggestions for Further Studies

1. The Impact of AI-Driven Learning Tools on Student Engagement and Learning Outcomes in Agricultural Education.
2. Effectiveness of AI-Powered Precision Farming Techniques in Vocational Agricultural Training.
3. Comparative Study of Traditional vs. AI-Assisted Teaching Methods in Agricultural Science Education.

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